

## CLAIMS

What is claimed is:

*Sub 1 A)*

1. A method for managing data in a data storage system, the data storage system including a plurality of physical storage devices, the method comprising the steps of:
  - 3       a) providing a plurality of modules, each of the plurality of modules including at least one child;
  - 5       b) receiving an input command related to the data by one of the plurality of modules from a source, wherein the source is transparent to the one module;
  - 7       c) deciding which child of the at least one children to pass the input command; and
  - 8       d) passing the input command to the decided child for processing the data according to the input command.
- 1       2. The method of claim 1, wherein the source comprises another module.
- 1       3. The method of claim 1, wherein the one module is the child of another module.
- 1       4. The method of claim 1, wherein the source is a client computer.

1           5. The method of claim 1 further comprising the step of:  
2           e) determining whether the decided child is another module of the plurality of  
3       modules; and  
4           f) repeating steps b) – d) if the decided child is determined to be another module.

1           6. The method of claim 5 further comprising the step of:  
2           g) if the decided child is determined in step e) to be a physical storage device,  
3       accessing the data stored in the physical storage device according to the input command.

1           7. The method of claim 6, wherein the accessing step g) further comprising:  
2           g1) building commands in the physical storage device to process the input  
3       command; and  
4           g2) executing the commands in the physical storage device.

1           8. The method of claim 7, wherein the physical storage device is a disk drive.

1           9. The method of claim 8, wherein the built commands are small computer system  
2       interface (SCSI) commands.

1           10. The method of claim 7, further including the step of:

2            h)       returning a status message from the decided child module to the parent module;

3           and

4           i)       repeating step h) until the parent module is an operating system of a host.

1           11. A computer readable medium containing programming instructions for managing  
2           data in a data storage system, the data storage system including a plurality of disk drives, the  
3           programming instructions for:

4           a)       providing a plurality of modules, each of the plurality of modules including at  
5           least one child;

6           b)       one of the plurality of modules receiving an input command from a source,  
7           wherein the source is transparent to the one module;

8           c)       deciding which child of the at least one children to pass the input command; and

9           d)       passing the input command to the decided child for processing.

1           12. The computer readable medium of claim 11, wherein the source comprises another  
2           module.

1           13. The computer readable medium of claim 11, wherein the one module is the child of  
2           another module.

1           14. The computer readable medium of claim 11, wherein the source is a client computer.

1           15. The computer readable medium of claim 11, further comprising the instructions for:

2           e)       determining whether the decided child is another module of the plurality of  
3           modules; and  
4           f)       repeating steps b) – d) if the decided child is determined to be another module.

1           16. The computer readable medium of claim 15 further comprising the instruction for:

2           g)       if the decided child is determined in step e) to be a disk drive,  
3           accessing the data stored in the disk drive according to the input command.

1           17. The computer readable medium of claim 16, wherein the accessing instruction g)  
2           further comprising:

3           g1)      building commands in the disk drive to process the input command; and  
4           g2)      executing the commands in the disk drive.

1           18. The computer readable medium of claim 17, wherein the built commands are small  
2           computer system interface (SCSI) commands.

1           19. The computer readable medium of claim 17, further including the instructions for:

2           h)       returning a status message from the decided child module to the parent module;  
3           and  
4           i)       repeating step h) until the parent module is an operating system of a host.

*Sub A1*

1        20. A system for managing data in a data storage system, the data storage system  
2        including a plurality of physical storage devices, the system comprising:  
3              a host computer for allowing a user to enter an input command related to data in the data  
4              storage system;  
5              a controller having an input coupled to the host computer and an output coupled to the  
6              plurality of physical storage devices, the controller further comprising:  
7                  a plurality of modules, each of the plurality of modules including at least one  
8                  child;  
9                  means for one of the plurality of modules receiving the input command from a  
10                 source, wherein the source is transparent to the one module;  
11                 means for deciding which child of the at least one children of the one module to  
12                 pass the input command; and  
13                 means for passing the input command to the decided child for processing the data  
14                 in accord with the input command.

1        21. The system of claim 20, wherein the source is another module.

1        22. The system of claim 20, wherein the one module is the child of another module.

1        23. The system of claim 20, wherein the source is the host computer.

1           24. The system of claim 20, wherein the decided child is one physical storage device of  
2           the plurality of physical storage devices.

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1           25. The system of claim 24, further comprising means for accessing the data stored in the  
2           one physical storage device.

1           26. The system of claim 25, wherein the means for accessing the data includes a plurality  
2           of control chips coupled to the controller, each control chip coupled to a corresponding physical  
3           storage device of the plurality of physical storage devices, wherein each control chip includes  
4           means for building commands to access the data in the corresponding physical storage device in  
5           accordance with the input command.

1           27. The system of claim 26, wherein the commands are small computer system interface  
2           (SCSI) commands.

1           28. A method for rebuilding a disk drive in a redundant data storage system having a  
2           plurality of disk drives, wherein one of the disk drives becomes degraded, the method comprising  
3           the steps of:

4           Sub A1

5           a)       providing a plurality of modules, each module including a plurality of children,  
6           wherein the plurality of children are disk drives and wherein a degraded module includes a  
7           degraded child which is the degraded disk drive;

8           b)       detecting the presence of a new disk drive replacing the degraded disk drive;

9           c)       creating a spanned partition;

10          d)       coupling the spanned partition to the degraded module; and

11          e)       rebuilding the new disk drive by the spanned partition, such that the new disk  
drive includes data stored in the degraded disk drive.

1           29. The method of claim 28, wherein the rebuilding step (e) further comprising:

2           e1)      creating a nondegraded module, wherein the nondegraded module is  
3           identical to the degraded module except that the degraded child is replaced by a new child  
4           which is the new disk drive;

5           e2)      coupling the nondegraded module to the spanned partition;

6           e3)      reading data from the children of the degraded module;

7           e4)      determining data in the degraded child from the data read in step (f3); and

8           e5)      writing the data determined in step (e4) to the new child in the  
9           nondegraded module.

1           30. The method of claim 29, further including the steps of:

2           f) decoupling the degraded module and the nondegraded module from the spanned  
3           partition;

4           Sub A/

5           g) replacing the degraded module with the nondegraded module;  
6           h) discarding the degraded module; and  
7           i) extracting the spanned partition.

1           31. A computer readable medium containing programming instructions for rebuilding a  
2           physical storage device in a redundant data storage system having a plurality of physical storage  
3           devices, wherein one of the physical storage devices becomes degraded, the instructions  
4           comprising:

5           a) providing a plurality of modules, each module including a plurality of children,  
6           wherein the plurality of children are physical storage devices and wherein a degraded module  
7           includes a degraded child which is the degraded physical storage device;

8           b) detecting the presence of a new physical storage device replacing the degraded  
9           physical storage device;

10          c) creating a spanned partition;

11          d) coupling the spanned partition to the degraded module; and

12          e) rebuilding the new physical storage device by the spanned partition, such that the  
13          new physical storage device includes data stored in the degraded storage device.

1           32. The computer readable medium of claim 31, wherein the rebuilding instruction (e)  
2        further comprising:

3           e1)    creating a nondegraded module, wherein the nondegraded module is  
4        identical to the degraded module except that the degraded child is replaced by a new child  
5        which is the new physical storage device;  
6           e2)    coupling the nondegraded module to the spanned partition;  
7           e3)    reading data from the children of the degraded module;  
8           e4)    determining data in the degraded child from the data read in step (f3); and  
9           e5)    writing the data determined in step (e4) to the new child in the  
10      nondegraded module.

1           33. The computer readable medium of claim 32, further including the instructions for:  
2           f)    decoupling the degraded module and the nondegraded module from the spanned  
3        partition;  
4           g)    replacing the degraded module with the nondegraded module;  
5           h)    discarding the degraded module; and  
6           i)    extracting the spanned partition.